Appendix A. Sample Air Cleaning Equipment Specifications

EQUIPMENT SPECIFICATION ES-1

HEPA FILTER

1. SCOPE

This specification covers basic requirements for HEPA (high efficiency particulate air) filters for use in supply-air, contaminated exhaust, contaminated air-cleanup, and other nuclear and hazardous air-cleaning applications requiring extremely high arresting efficiency for all sizes, including submicron, of particulate matter.

2. CLASSIFICATION

HEPA filters are classified by size and construction in accordance with Tables 1 and 2.

Table 1. Standard Filter Sizes

Size	Nominal Airflow Capacity (scfm)	Face Dimensions (in.)	Depth (in.)
1	25	8 x 8	3-1/16
2	50	8 x 8	5-7/8
3	125	12 x 12	5-7/8
4	500	24 x 24	5-7/8
5	1000	24 x 24	11-1/2

Table 2. Standard Filter Constructions

Group	Type	Frame Material	Separator Material
1	I-A	Cadmium-plated carbon steel	Made without separators
	I-B	Cadmium-plated carbon steel	Aluminum
	I-C	Cadmium-plated carbon steel	Water-proof asbestos
	I-D	Cadmium-plated carbon steel	Corrosion-resistant
	II-A	Chromized steel	Made without separators
	II-B	Chromized steel	Aluminum
	II-C	Chromized steel	Water-proof asbestos
	II-D	Chromized steel	Corrosion-resistant
2	III-A	Plywood, Exterior Grade	Made without separators
	III-B	Plywood, Exterior Grade	Aluminum
	III-C	Plywood, Exterior Grade	Water-proof asbestos
	III-D	Plywood, Exterior Grade	Corrosion-resistant
	IV-A	Wood Ptcl. Board, Ext. Gr.	Made without separators
	IV-B	Wood Ptcl. Board, Ext. Gr.	Aluminum
	IV-C	Wood Ptcl. Board, Ext. Gr.	Water-proof asbestos
	IV-D	Wood Ptcl. Board, Ext. Gr.	Corrosion-resistant

3. REFERENCE DOCUMENTS

The following documents are a part of this specification to the extent specified in the text. The issue of one of these documents in effect on the date of the invitation to bid, including any amendments or other published changes in effect on that date, shall apply. If the specification appears to conflict with the requirements of a referenced document, such conflict shall be brought to the attention of the purchaser for resolution.

3.1 Military Specifications and Standards.

MIL-S-46055 *Steel, Sheet and Strip, Low Carbon, Chromized*

MIL-F-51068 *Filter, Particulate, High-Efficiency, Fire-Resistant*

MIL-F-51079 *Filter Medium, Fire-Resistant, High-Efficiency*

MIL-STD-282 *Filter Units, Protective Clothing, Gas-Mask Components, and Related Products, Performance Test Methods*

3.2 ERDA Health & Safety Bulletins (Energy Research and Development Administration).

Filter Unit Inspection and Testing Service (issued annually, number changes with each issue).

3.3 ASTM Standards (American Society for Testing and Materials).

ASTM A 165 *Electrodeposited Coatings of Cadmium on Steel*

ASTM A 366 *Cold-Rolled Carbon Steel Sheets, Commercial Quality*

ASTM D 905 *Strength Properties of Adhesive Bonds in Shear by Compressive Loading*

ASTM D 1056 *Sponge and Expanded Cellular Rubber Products*

ASTM E 84 *Surface Burning Characteristics of Building Materials*

3.4 TAPPI Standards (Technical Association of the Pulp and Paper Industry)

TAPPI T404 *Tensile Breaking Strength of Paper and Paperboard*

TAPPI T411 *Test for Thickness and Density of Paper*

TAPPI T413 *Ash in Paper*

3.5 NBS Standards (National Bureau of Standards).

NBS PS-1 *Product Standard for Softwood Plywood, Commercial and Industrial*

NBS CS-236 *Commercial Standard for Mat-Formed Wood Particleboard*

3.6 UL Standards (Underwriters' Laboratories)

UL-586 *Safety Standard for High-Efficiency Air Filter Units*

UL-900 *Safety Standards for Air Filter Units*

3.7 IES Standards (Institute of Environmental Sciences, formerly American Association for Contamination Control).

CS-1 *Standard for HEPA Filters*

4. TECHNICAL REQUIREMENTS

4.1 Performance. Filters shall have a maximum penetration of 0.03% (i.e., a minimum efficiency of 99.97%) when tested with monodisperse dioctylphthalate (DOP) smoke having a light-scattering mean droplet diameter of 0.3 micron when operated at rated airflow capacity and at 20% of rated airflow capacity. Maximum clean-filter pressure drop (resistance) across the filter when operated at rated airflow capacity shall be 1.0 inch of water.

4.2 Materials

4.2.1 Filter Medium: glass or glass and asbestos fiber paper having the following properties:

a. DOP Penetration: 0.03% maximum when tested in accordance with Method 502.1.1 of MIL-STD-282.

b. Airflow Resistance: 40 mm water max., when tested at 32 liters/min./sq.ft. of medium, in accordance with Method 402.1.1 of MIL-STD-282.

c. Thickness: 0.15 inch minimum, when tested in accordance with TAPPI T411.

d. Basis Weight (density): 48 lbs per 3000 sq. ft. when tested in accordance with TAPPI T411.

e. Tensile Strength: 2.5 lb/inch width, minimum, in both machine and cross-machine direction, when tested in accordance with TAPPI T404.

f. Elongation: 1.0% minimum at rupture in both machine and cross-machine direction, when tested in accordance with TAPPI T404.

g. Wet Tensile Strength: 1.25 lb/inch width, minimum, when tested in accordance with TAPPI T404 after soaking in water for 15 minutes.

h. Water repellency: 0 penetration of medium under 30-inch head of water when tested in accordance with Method 603.1 of MIL-STD-282.

i. Folding Characteristics: medium shall show no tears, breaks, or cracks when a specimen, cut in the machine direction, is bent 180° around a 1/16-in. diameter mandrel. Folded tensile = 50% original tensile, minimum.

j. Combustible Content: 5.0% maximum when tested in accordance with TAPPI T413.

k. Tensile Strength After Irradiation: not less than 1.0 lb per in. of width in both the machine and cross direction when tested in accordance with e., above, after exposure to an integrated gamma radiation dose of 6.4×10^7 rad.

l. Water Repellency After Irradiation: 0 penetration of medium under 6 in. head of water when tested in accordance with h., above, after exposure to an integrated gamma radiation dose of 6.4×10^7 rad.

4.2.2 Case Materials:

a. Type I case: No. 14 US gage carbon steel, ASTM A366.

b. Type II case: No. 14 US gage chromized steel, MIL-S-46055, Type I.

c. Type III case: 3/4-inch fire-retardant treated Grade A-A exterior plywood in accordance with PS-1, having a flame-spread classification of 25 or less when tested in accordance with ASTM E84.

d. Type IV case: 3/4-inch phenolic-resin-bonded exterior wood particle board, batch-treated for fire retardance before forming, in accordance with CS-236 except minimum density shall be 45 lb/cu ft; filled both sides, flame-spread classification of 25 or less when tested in accordance with ASTM E84.

4.2.3 Separator Materials shall meet the following requirements.

a. Type B Separators: aluminum alloy 3003-H19 or 5052-H39, 0.0015 inch thick minimum.

b. Type C Separators: asbestos paper, 4 lb/100 sq ft minimum density, containing no more than 5% combustible materials, qualified in accordance with Appendix A.

c. Type D Separators: asbestos paper, same as Type C, TFE-plastic coated aluminum, or other non-flammable material, qualified in accordance with Appendix B.

4.2.4 Sealants and Adhesives. Sealants used to seal the filter pack into the frame shall have a minimum shear value of 100 psi at 225°F wood (maple or birch) to wood when tested in accordance with ASTM D 905 under a compression loading rate of 0.1 to 0.2 inch per minute. Adhesives used to glue the gaskets to the frame shall have a minimum peel strength of 10 lb per inch at room temperature, metal surface to neoprene surface. All sealants and adhesives shall be oil resistant and self-extinguishing after exposure to open flame.

4.2.5 Gasket Material shall be oil-resistant, ozone resistant, closed cell neoprene sponge, ASTM D 1056, Grade SCE-43, 1/4 inch thick by 5/8 to 3/4 inch wide (+ 1/8 inch, - 0 inch), with cut surfaces on both faces.

4.2.6 Face Guards, when specified, shall be 4 x 4 mesh galvanized hardware cloth, expanded-and-flattened expanded metal with maximum openings of 1 x 1/2 inch, or perforated metal having maximum openings of 1/2 x 1/2 inch. Pressure drop of filters with face guards shall not exceed the requirements of 4.1.

4.3 Construction.

4.3.1 Filters shall be Grade 1 (fire resistant) construction in accordance with Section 6 of IES CS-1, and shall meet the construction requirements of Section 8 of that standard. Case and separator materials shall be as specified by the purchaser; separatorless construction shall be furnished only when specified by the purchaser.

4.3.2 The filter pack of a size 1 or 2 filter shall contain no splices. The filter pack of a size 3 filter may contain one splice. The filter pack of a size 4 or 5 filter shall contain no more than three splices. Splicing shall be in accordance with Section 8.3(1) of AACC CS-1.

4.3.3 Filter media shall not be spot-patched to repair holes or tears, but may be repaired in accordance with Section 8.e.(3) of AACC CS-1.

4.3.4 Edges of separators (except Type A construction) shall extend at least 1/8 inch beyond the pleats and no closer than 3/16 inch to the plane of the face of the frame. Pleats and separators shall not be kinked more than 1/4 inch from a straight line drawn from end to end of the pleat, and shall be perpendicular to the frame with $\pm$ 3/8 inch as measured from a perpendicular to the frame drawn from the opposite end of the pleat. The filter core shall be tight when tested as specified in Section 5.3.2.

4.3.5 Group 1 (metal cased) Filters:

a. At least the top and bottom case panels of each filter shall have a 3/8-inch to 1/2-inch flange on the inside, front and back, to restrain movement of the filter pack after assembly of the filter. Case shall have a double-turned 3/4-inch-wide flange on each face. (See Fig. 1.)

b. Individual case panels for Type I construction shall be cadmium plated after completion of all shearing, forming, and spot-welding operations, but before assembly into a complete case. Plating shall be Type OS or heavier, in accordance with ASTM A165.

c. Cases may be assembled with stainless steel, cadmium plated, nickel plated, or chromium plated rivets, bolts, screws, or drive screws. Joint surfaces of individual panels shall be thoroughly coated with adhesive before assembly into the case to ensure a leak-tight corner joint, and assembled case shall meet the dimensional tolerances of 8.b and 8.c of AACC CS-1. Contact areas between the case and the filter pack shall be thoroughly coated with adhesive (sealant) before assembly to ensure a leak-tight assembly.

4.3.6 Group 2 (wood cased) Filters:

a. Cases shall have single-rabbeted corners as shown in Fig. 2 and shall be assembled by double-nailing or double screwing with coated box nails or galvanized flat-head wood screws. Points of fasteners shall not penetrate any surface of the case. Joint surfaces shall be thoroughly coated with adhesive before assembly to ensure a leak-tight joint. Contact areas with the top, sides, and bottom of the filter core shall be coated with adhesive to minimize any possibility of edge-to-edge leakage through the frame.

b. Cases of Type III (plywood case) filters shall be assembled with the Grade A surface of the plywood on the inside, adjacent to the filter core. Any defects in the outer (Grade B) surface shall be coated with adhesive to prevent leakage through the panel.

4.3.7 Dimensional and Assembly Tolerances:

a. Face Dimensions: Less than 24 inches: + 0, —1/16 in.
24 inches and over: + 0, —1/8 in.

b. Depth: + 1/16 in., —0.

c. Squareness: Face diagonals of both faces of Sizes 1, 2, and 3 filters shall be equal within 1/16 inch total allowance; face diagonals of both faces of larger filters shall be equal within 1/8 inch total allowance.

d. Faces: Gasket seating surfaces shall be square with the sides of the frame within ± 3 degrees, and shall be flat and parallel within 1/16 inch total allowance when measured with one face of the filter resting on a surface plate. Sides of the assembled case shall not bow inward or outward more than 1/16 in. in 12 inches, measured on the outside of the case.

4.4 Gaskets. Filters shall have a gasket on one face only unless otherwise specified by the purchaser. Gaskets shall be made from strips of neoprene cemented evenly to the flange surface with a rubber-base adhesive; the surface of the flange surface shall be cleaned with a degreasing solvent (fluorocarbon, trichloroethylene, acetone, etc.) before cementing the gasket. Gasket strips shall have keyhole or dovetail joints at the corners and shall not be spliced between the corners; edges of the joint surfaces shall be coated with adhesive during assembly to ensure a leak-tight joint. There shall be no evidence of adhesive, cohesive, or contact failure in the joint between the gasket and the flange face. After curing of the adhesive gaskets shall have a minimum peeling strength of 10 lb per inch of width.

4.5 Face Guards. Size 4 and 5 filters shall have face guards installed on both faces unless otherwise specified by the purchaser. Face guards shall be firmly embedded all around, with no projecting wires or edges that might penetrate the filter medium or be safety hazards to personnel handling the filters.

4.6 Marking. Each filter shall be marked on the top panel with the following information; marking shall be oriented to read from the downstream side, relative to the position of the filter during test (Section 4). Marking shall be by indentation-stamping or indelible ink; ink characters shall be at least 1/4 inch high and shall be clear and distinct; variable data (penetration and pressure drop values) may be handwritten; serial number shall be printed. Marking shall not be furnished on a paper label. Marking shall include the following information:

- Manufacturer's name or symbol
- Percent penetration, actual, at rated capacity (all sizes)
- Percent penetration, actual, at 20% of rated capacity (Sizes 4 and 5 only)
- Filter serial number
- Airflow capacity, cfm
- Pressure drop at rated capacity (all sizes)
- Pressure drop at 20% of rated capacity (Sizes 4 and 5)

5. QUALITY ASSURANCE REQUIREMENTS

5.1 Quality Assurance Plan. Filters shall be manufactured under the surveillance of a formal quality assurance program, in accordance with formalized and documented manufacturing and quality assurance plans. Quality assurance personnel shall not report to the production manage of the manufacturer's plant.

5.2 Qualification. The filter design, construction, and medium shall be qualified in accordance with the following requirements. Qualification tests shall be made by the manufacturer, a qualified testing laboratory mutually acceptable to the manufacturer and the purchaser, or by the U. S. Army. Listing of the item in a Military Qualified Products List shall be objective evidence that the product meets the qualification requirements. Once qualified, a given filter design need not be requalified for subsequent shipments to this or other pruchasers unless there has been a change in design, method of manufacturer, or materials, except each manufacturing lot of filter medium shall be tested as specified below.

5.2.1 Filter Medium. Each manufacturing lot of filter medium shall be tested in accordance with the requirements of MIL-F-51079 except with the following modifications: (NOTE: paragraph numbers in text of requirements below refer to the paragraph numbers of MIL-F-51079):

a. Tensile Strength and Elongation. Twenty machine-die-cut specimens, each 1 inch x 6 inches in length, 10 having the long dimension parallel to the machine direction and 10 having the long dimension parallel to the cross direction, shall be conditioned and tested for tensile strength and elongation in accordance with TAPPI T404, using a motorized Instron University Testing Machine at a loading rate of 0.5 inch per minute, or at a loading rate which will complete the test in 10 $\pm$ 2 seconds, whichever is greater.

b. Tensile Strength After Heated Air. Delete in its entirety.

c. Wet Tensile Strength. Ten test specimens, each 1 inch x 6 inches, five having the long dimension parallel to the machine direction and five having the long dimension parallel to the cross direction, shall be submerged in water at a depth of at least 10 inches for at least 15 minutes, and then tested for wet tensil strength as specified in 4.2.4.2(a). The average of the test results shall be considered the wet tensile strength of the medium.

d. Water Repellency. Three test specimens, each 2-3/4 inches x 5-1/2 inches, shall be tested for water repellency using the Q101 Water Repellency Indicator (DLB-125-8-1). Each specimen shall be cut into two equal size squares. The felt (top) side of one square and the wire (bottom) side of the other square shall be tested; the lesser of the two results shall be considered the water repellency of the specimen. The minimum water repellency of the three specimens shall be considered the water repellency of the medium.

e. Mildew Resistance. When specified in the Ordering Data, mildew resistance tests of the medium shall be conducted in accordance with method 5750 of FED TEST METHOD 191.

f. Acidity. Delete in its entirety.

g. Thickness. The thickness of the medium shall be determined in accordance with TAPPI standard T411, using a TMI No. 549-M Thickness Tester with 5/8 inch diameter anvils.

h. Combustibles Content. The dried weight of the sample shall be recorded. The ash weight shall be determined in accordance with TAPPI standard T413, except the sample shall be either heated for 2 hours at 800°C or for minutes at 1000°C. Percent combustible content shall be determined from the equation:

$$\text{Percent Combustible} = \frac{\text{Sample weight - Ash weight}}{\text{Sample weight}} \times 100$$

i. Radiation Resistance. Radiation resistance of the medium shall be determined as follows: Twenty 1-inch x 6-inch tensile-test specimens (10 with the long dimension parallel to the machine direction and 10 with the long dimension parallel to the cross direction) and three 2 3/4 x 5 1/2 inch water repellency specimens shall be subjected to gamma radiation. Irradiated tensile test specimens shall be tested in accordance with 4.2.4.2(a). Irradiated water repellency specimens shall be tested in accordance with 4.2.4.3.

5.2.2 Filter Design and Materials. Filter design and materials of construction shall be tested for qualification as follows:

a. Resistance to Fire and Hot Air. Each filter design and combination of materials of construction shall be tested for qualification in accordance with UL-586 or the requirements for heated-air and spot-flame resistance of MIL-F-51068. Presence of the Underwriters' Laboratories label certifying compliance with UL-586, or listing of the design in a military Qualified Products List, shall be satisfactory evidence of compliance with this requirement.

b. Resistance to Moisture and Overpressure. Each filter design and combination of materials of construction shall be tested for qualification as follows:

> Operating at rated capacity, the test filters (at least four of the design to be qualified) shall withstand a load of water spray that will produce a pressure differential across the filter core of 10 in. water guage for one hour without permanent damage, as determined by testing, after the filter is dried, in accordance with 5.3. The filter, when tested after drying, shall meet the requirements of 4.1 and the dimensional requirements of 4.3.6-a, b, and c.

Listing of the design in a military Qualified Products List shall be satisfactory evidence of compliance with this requirement.

c. Resistance to Rough Handling. Each filter design and combination of materials of construction shall be tested for qualification as follows:

> The test filters (at least two of the size and design to be qualified) shall withstand rough handling in accordance with Method 105.9 of MIL-STD-282 for 15 min. at 3/4 in. total amplitude and a frequency of 200 Hz, with pleats and filter faces in a vertical orientation, without visible damage or loss of filtration efficiency, as determined by testing in accordance with 4.3.1. After rough handling, the filters shall meet the requirements of 4.1 and 4.3.6-a, b, and c.

Listing of the design in a military Qualified Products List shall be satisfactory evidence of compliance with this requirement.

5.2.3 Separator Materials. Asbestos separator material shall be qualified in accordance with Appendix B of this specification. Corrosion-resistant separator material shall be qualified in accordance with Appendix C of this specification. Test results of qualification tests shall be made available to the purchaser on request.

5.3 Production Lot Testing.

5.3.1 Performance Test. Each filter element shall be individually tested for DOP penetration and airflow resistance in accordance with Method 102.9.1 of MIL-STD-282 except: (1) the Q-107 or Q-76 filter testing penetrometer shall be modified to permit the complete filter element to be encapsulated during test in order to establish the presence of frame leaks; (2) tests shall be conducted with the filter element encapsulated; (3) tests shall be made and reported at 100% of rated capacity and also, for filters larger than 125 cfm rated capacity, at 20% of rated capacity. The results of tests shall be marked on the case of the filter element; test reports are not required unless expressly specified by the purchaser, and shall comply with the requirements of 4.1. Filters which fail this test shall be rejected.

5.3.2 Core-Tightness Test. A test shall be made of the tightness of the filter core. The test may be made on a number of filters corresponding to at least 5% of the number of filters in the shipment, but no fewer than 5 filter elements. The test is made as follows:

Lay filter face down on a flat surface. Place a 4-x-6-inch block of wood, covered with a neoprene pad glued to one surface, at the center of the filter face. Place a 4-lb weight on the block. A force of 4 lbs exerted on the block in a direction parallel to the face of the filter and perpendicular to the pleats shall cause the block to move no more than 1/16 inch from its original position in either direction.

Failure to meet the requirements of this test shall be cause for rejection of the shipment.

5.4 Tests By ERDA Quality Assurance Station. When specified by the purchaser, filters shall be shipped to one of the ERDA Quality Assurance Stations in accordance with instructions contained in the current issue of the ERDA *Health and Safety Bulletin* on Filter Unit Inspection and Testing. The Quality Assurance Station shall inspect each filter to verify that it complies with this specification and that it is free of visible damage, evidence of poor workmanship, and errors in manufacture, and shall test the filters in accordance with 5.3 above. The Quality Assurance Station shall then repack the filters in the manner in which they were shipped, to them, and ship them to the specified delivery site in accordance with the purchaser's instructions. Acceptance of filters shall be at the Quality Assurance Station upon successful completion of the requirements of this section.

6. PREPARATION FOR DELIVERY

6.1 Filter Packaging. Filters shall be individually packaged or packed with individual corrugated paperboard separators in wood or corrugated paperboard cartons having corner braces, inserts, or other means of shock prevention to protect the filters from damage during handling, shipping, and storage. Size 4 and 5 filters shall be enclosed within a corrugated paperboard sleeve having integral spacers to hold the filter, while in the carton, at least 1 inch from all walls of the carton (separate spacers may be used at the top and bottom of the filters), or be protected with plywood or heavy-paperboard on each face, with spacers to hold the filter, while in the carton, at least 1 inch from all walls of the carton.

6.1.1 Filters shall be placed in the carton so that the faces and the pleats are vertical when the carton is in its normal shipping orientation. Cartons shall be marked FRAGILE - HANDLE WITH CARE and THIS SIDE UP, or similar legends, in black or red heavy block characters at least 3/4 inch high.

6.1.2 Packing and packaging shall be of a type, weight, thickness and material which is acceptable to the public carrier in compliance with Uniform Freight Classification Rules, the National Motor Freight Classification Rules, or other applicable freight classification rules.

6.2 Shipping.

6.2.1 Loading in Public Carriers. Cartons shall be banded to skids so that the specified filter orientation is maintained during shipment, or packed in the carrier's truck or railroad car so that the specified filter orientation is maintained. Cartons shall not be stacked more than 6-1/2 ft high unless a platform is provided to support the tiers of cartons above the 6-1/2 ft height, and other materials shall not be stacked on top of the filter cartons during shipment. A packing list shall be affixed to the outside of one carton of each shipping unit (one skid or pallet load comprises a shipping unit) giving the name of the manufacturer, description of contents, quantity in the order, quality in the shipping unit, indication that the shipment is partial or complete, name of purchaser, and purchaser's order number.

6.2.2 Transhipment. If possible, shipment shall be arranged so that the filters are not disturbed after they leave the manufacturer's plant until they are received at the USERDA Quality Assurance Station, and, after leaving the Quality Assurance Station, until they are received at the delivery site. The common carrier should be instructed that Quality Assurance Station and Purchaser's personnel, respectively, shall be responsible for unloading the truck or railroad car. Railroad cars shall be marked, DO NOT HUMP. The carrier shall report all transshipments to the purchaser.

6.2.3 Sealed Trailer. When specified by the purchaser, filter shall be transported to the delivery site (and to and from the ERDA Quality Assurance Station, when specified) in a sealed trailer or containerized-freight unit. Filters shall be packed and oriented in the trailer or containerized-freight unit as specified in 6.2.1 above.

7. PURCHASE DOCUMENT

Purchase documents for filters bought in accordance with this specification shall (1) cite the number and title of this specification; (2) show the size (see Table 1) and type of construction required (see Table 2); (3) specify gaskets on both faces, if required (4.4); (4) specify face guards, if required (4.5); (5) specify shipment to and testing by an ERDA Quality Assurance Station, with address of station, if required (5.4); (6) specify any special packing or packaging requirements (6.1); (7) method of shipment (6.2); and (8) specify any exceptions to the specification.

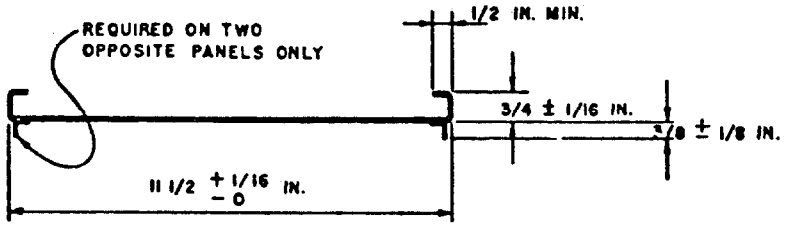

Fig. 1 Section through case panel, metal-cased HEPA filter.

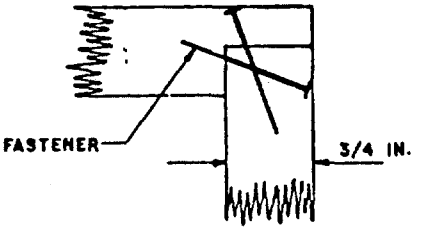

Fig. 2 Corner detail, wood-cased HEPA filter.

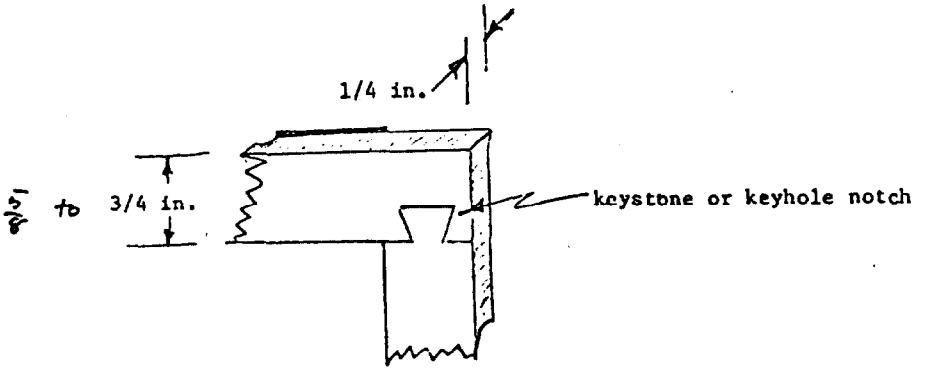

Fig. 3 Corner detail, flat neoprene gasket.

A P P E N D I C E S

A. QUALIFICATION TEST FOR MOISTURE RESISTANCE OF SEPARATOR MATERIALS

Ten sections of corrugated separator, each 4 inches long and containing 5 corrugations, shall be immersed in tap water containing 2 to 3 percent by weight trisodium phosphate base detergent for one hour. After soaking, each section, in turn, shall be laid flat and a load of 1/2 lb evenly distributed over the tops of the corrugations, shall be placed on the sample. None of the sample shall flatten, and corrugations shall not decrease in height by more than 50 percent.

B. QUALIFICATION TEST FOR CORROSION RESISTANCE OF SEPARATOR MATERIALS

1. Equipment Requirements. Taber V-5 Stiffness Tester and Taber Specimen Shear.

2. Preparation of Test Specimens. Cut 33 test specimens from flat stock, using specimen shear, with long dimension of specimen parallel to machine direction of stock. Divide specimens into eleven sets of two specimens per set, and number each specimen with a set identification. Measure the thickness of each specimen at each end and at the center in accordance with TAPPI T411. Record average weight of each specimen.

3. Conditioning. Condition each set of specimens as follows:

Set # 1 Control sample; do not condition.

Set # 2 Soak in 25°C water for 1 hour.

Set # 3 Immerse in 6M HCl for 2 minutes, blot, and soak in 25°C water for 1 hours.

Set # 4 Immerse in 10% HF solution for 1 minute, blot, and soak in 25°C water for 1 hour.

Set # 5 Immerse in 6M $HClO_4$ for 2 minutes, blot, and soak in 25°C water for 1 hour.

Set # 6 Immerse in 9M H_2SO_4 for 2 minutes, blot, and soak in 25°C water for 1 hour.

Set # 7 Immerse in 7.5M HNO_3 for 2 minutes, blot, and soak in 25°C water for 1 hour.

Set # 8 Immerse in 50% NaOH solution for 2 minutes, blot, and soak in 25°C water for 1 hour.

Set # 9 Steam for 6 hours at approximately atmospheric pressure, blot and soak in 25°C water for 1 hours.

Set #10 Steam for 3 hours at approximately 25 psig, blot, and soak in 25°C water for 1 hour.

Set #11 Heat in furnace at 850°F for 5 minutes cool for 5 minutes, and soak in water for 1 hour.

4. Stiffness Determination. Blot specimen, determine stiffness with Taber V-5 Stiffness Tester while still wet; record stiffner value. Dry specimen and repeat. Average stiffness values for each set; report test values and average-wet-and-dry-stiffness values for each set.

5. Acceptance. Minimum average wet stiffness of any set shall be 10 Taber Stiffness Units. Minimum average dry stiffness of any set shall be 12 Taber Stiffness Units.